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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|-------------|------------------------|---------------------|------------------|
| 10/708,649 | 03/17/2004 | Kamalesh K. Srivastava | FIS920030359US1 | 2648 |
| 29371 | 7590 | 07/12/2005 | EXAMINER | |
| CANTOR COLBURN LLP 55 GRIFFIN ROAD SOUTH BLOOMFIELD, CT 06002 | | | CAO, PHAT X | |
| | | | ART UNIT | PAPER NUMBER |
| | | | 2814 | |

DATE MAILED: 07/12/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

| | | | |
|------------------------------|------------------------|---------------------|--|
| Office Action Summary | Application No. | Applicant(s) | |
| | 10/708,649 | SRIVASTAVA ET AL. | |
| | Examiner | Art Unit | |
| | Phat X. Cao | 2814 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 12 May 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) 1-5 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 6-8, 10, 11, 14, 15, 17 and 20 is/are rejected.
- 7) ☒ Claim(s) 9, 12, 13, 16, 18 and 19 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date <u>3/17/04</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of claims 6-20 in the reply filed on 5/12/05 is acknowledged.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claim 17 is rejected under 35 U.S.C. 102(b) as being anticipated by Rinne (US. 6,492,197).

Rinne (Fig. 3) discloses a method for introducing a self etch stop mechanism within a metallic thin film 130, the method comprising: forming an overlayer 150 upon the thin film 130; annealing the thin film 130 (column 6, lines 40-47) so as to cause atoms from the overlayer 150 to diffuse into the thin film 130C thereunderneath to form an intermetallic layer 130C' (column 6, lines 58-65); wherein the annealing causes diffused regions 130C' (i.e., CuTi) of the thin film 130 to have an altered electrical resistivity and electrode potential with respect to undiffused regions of the thin film 130 comprising Cr/CrCu/Cu.

3. Claims 6, 10-11, 14, 15, 17 and 20 are rejected under 35 U.S.C. 102(b) as being anticipated by Andricacos et al (US. 5,937,320).

Regarding claims 6, 11 and 17, Andricacos (Figs. 3a-3h) discloses a method for

forming an interconnect structure for a semiconductor device or a method for introducing a self etch stop mechanism within a metallic thin film 16, the method comprising: defining a via in a passivation layer 14 (Fig. 3a) so as to expose a top metal layer 12 in the semiconductor; forming a seed layer 16 over the passivation layer 14, sidewalls of the via, and the top metal layer 12 (Fig. 3b); forming a barrier layer 18 (column 5, lines 42-47) over an exposed portion of the seed layer 16, the exposed portion defined by a first patterned opening (Fig. 3d); and annealing the semiconductor device at a temperature of about 70 degrees C during plating the barrier layer 18 over the exposed portion of the seed layer 16 (column 6, lines 46-61), wherein the first patterned opening is formed using a photoresist material 22 that is capable of withstanding temperatures generated during the annealing.

It is noted that the annealing at a temperature of 70 degrees C during plating the barrier layer 18 over the seed layer 16 would inherently cause atoms from the barrier layer 18 to diffuse into the seed layer 16 by the chemical reactions to form a diffused alloy at their interface. The diffused alloy comprises an alloy of barrier layer 18 and seed layer 16 (i.e., CuNi) and would have an altered electrical resistivity and electrode potential with respect to undiffused regions of the seed layer 16 (i.e., Cu).

Regarding claims 10 and 15, Andricacos (Fig. 3e) further discloses the step of following the annealing during the plating of the barrier layer 18, forming a solder material 20a over the barrier layer 18 using the first patterning opening, and the step of removing copper and chrome copper portions 16c/16b by electroetching (see Fig. 2 and column 7, lines 37-39).

Regarding claims 14 and 20, Andricacos further discloses that the seed layer 16 comprises TiW/CrCu/Cu layer (column 6, lines 12-15), and the barrier layer 18 comprises a nickel/copper layer (column 6, lines 49-52 and column 7, lines 1-4).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 7-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Andricacos et al (US. 5,937,320) in view of Furuya (US. 6,613,663).

Regarding claim 7, Andricacos does not disclose that the remaining portions of the seed layer 16 after etching do not undercut the barrier layer 18.

However, Furuya (Figs. 3D-3E) teaches the step of etching the seed layer 22, wherein remaining portions of the seed layer 22 do not undercut the barrier layer 50. Accordingly, it would have been obvious to modify the etching process step of Andricacos by etching the seed layer to form the remaining portions of the seed layer do not undercut the barrier layer in order to simplify the process of forming a seed/barrier metal pad, as taught by Furuya (see Fig. 3E, column 5, lines 57-67).

Regarding claim 8, Andricacos does not disclose the step of forming the solder material 20 over the barrier layer 18 using a second patterned opening.

However, Furuya (Figs. 3e-3F) teaches the forming of solder material 70 over the barrier layer 50 using a second patterned opening formed by a mask layer 60 (column

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6, lines 1-8). Accordingly, it would have been obvious to modify the process of Andricacos by forming the solder material 20 over the barrier layer 18 using a second patterned opening (as suggested by Furuya) in order to adjust to the desired size for the solder ball interconnect.

Allowable Subject Matter

5. Claims 9, 12-13, 16 and 18-19 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

- dependent claim 9 is objected because the prior art of record fails to disclose the forming of the second patterned opening having a diameter larger than the diameter of the first patterned opening.
- dependent claims 12-13 and 18-19 are objected because the prior art of record fails to disclose the annealing being implemented at a temperature and a duration so as to cause atoms from the barrier layer to diffuse into the seed layer by about one micron in x, y and z-directions.
- dependent claim 16 is objected because the prior art of record fails to disclose the annealing being implemented at temperature of about 350 to about 380 degrees C for a duration of about 30 to about 45 minutes.

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Phat X. Cao whose telephone number is 571-272-1703. The examiner can normally be reached on M-F.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on 571-272-1705. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

PC
July 8, 2005


PHAT X. CAO
PRIMARY EXAMINER